MIXED REVIEW of Problem Solving

STATE TEST PRACTICE
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Lessons 7.5–7.7

1. MULTI-STEP PROBLEM The total expenditures in the United States for elementary and secondary schools are shown below.

a–b. See margin.

a. Draw a scatter plot of the data pairs $(x, \ln y)$.

b. Draw a scatter plot of the data pairs $(\ln x, \ln y)$.

c. Based on your results from parts (a) and (b), find a model for the original data. $y = 384(1.04)^x$

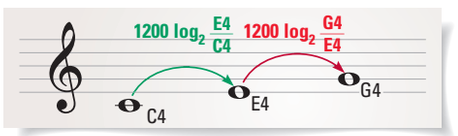
d. Predict the total expenditures in 2005. about $526 billion

Years since 1997, x	Total expenditures (billions of dollars), y
1	398
2	416
3	433
4	450
5	463

2. MULTI-STEP PROBLEM In music, a *cent* is a unit that is used to express a small step up or down in pitch. The number c of cents by which two notes differ in pitch is given by

$$c = 1200 \log_2 \frac{a}{b}$$

where a and b are the frequencies of the notes a and b.



a. Three notes on the standard scale are C4, E4, and G4. You can compare the difference in the number of cents from C4 to E4 with the difference from E4 to G4 by evaluating this expression:

$$1200 \log_2 \frac{\text{E4}}{\text{C4}} - 1200 \log_2 \frac{\text{G4}}{\text{E4}}$$

$1200 \log_2 \left(\frac{(\text{E4})^2}{\text{C4} \cdot \text{G4}} \right)$

Write the expression as a single logarithm.

b. C4 has a frequency of 264 hertz, E4 has a frequency of 330 hertz, and G4 has a frequency of 396 hertz. Use this information to evaluate your expression from part (a). 70.67 cents

3. OPEN-ENDED Write an exponential function whose graph passes through the point (2, 7). *Sample answer:* $y = 7^{x-1}$

4. SHORT RESPONSE The total number of miles traveled by motor vehicles in the United States is shown below for various years. Does an exponential model or a power model best fit the data? *Explain* your reasoning. See margin.

Years since 1990, x	Miles (billions), y
7	2562
8	2632
9	2691
10	2747
11	2782

5. EXTENDED RESPONSE The *effective interest rate* is a rate associated with the formula for continuously compounded interest. The effective interest rate takes into account the effects of compounding on the *nominal interest rate* (the interest rate in the formula for continuous compounding).

The relationship between the effective interest rate E and the nominal interest rate N is given by the equation

$$N = \ln (E + 1)$$

where E and N are expressed as decimals.

a. What is the effective interest rate for an account that has a nominal interest rate of 5%? Leave your answer in terms of e. $e^{0.05} - 1$

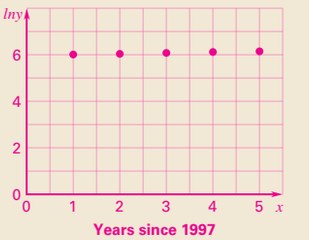
b. What is the effective interest rate for an account that has a nominal interest rate of 10%? Leave your answer in terms of e. $e^{0.1} - 1$

c. The effective interest rate from part (b) is how many times as great as the effective interest rate from part (a)? Write your answer as a ratio in terms of e. See margin.

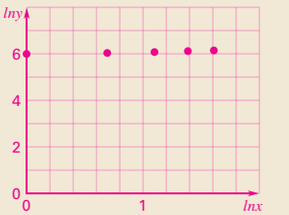
d. Show that the ratio from part (c) is equal to $e^{0.05} + 1$. See margin.

6. GRIDDED ANSWER You invest $4000 in an account that pays 2% annual interest compounded continuously. To the nearest year, how long will it take to earn $1000 interest? 11 yr

1a.



1b.



4. Power model. *Sample answer:* The points $(\ln x, \ln y)$ appear to be more linear than the points $(x, \ln y)$.

5c. $\frac{e^{0.1} - 1}{e^{0.05} - 1}$

5d. $\frac{e^{0.1} - 1}{e^{0.05} - 1} = \frac{(e^{0.05} - 1)(e^{0.05} + 1)}{e^{0.05} - 1} = e^{0.05} + 1$